# **GEOLOGY**

## Physiographic Region/Geology/Soils

The Fox River basin lies in the Eastern Section of the Glaciated Plains Natural Division (Thom and Wilson 1980) within the Dissected Till Plains physiographic region (Figure nd). This area is composed of rolling to steep glacially deposited hills over Mississippian and/or Pennsylvanian bedrock (Koenig 1961).

Surficial material of the region varies from deep loess and glacial drift in the northwest portion of the watershed, to steep, moderately deep and wooded glacial till slopes in the central and southeastern portions (Figure ge). The Mississippi River floodplain substratum consists of fine alluvium. Loess material is generally greater than 25 feet deep near the Mississippi River bluffs but thins to 4-8 feet at the western edge of the watershed (MDNR 1984, MDNR 1986).

The soils in the basin are generally characterized as a loamy-clay of loess and glacial till parent material with slow permeability and moderate to high erosion potential. Streams in the basin become turbid during intense storms but are moderately clear under normal flows.

For discussion in this plan, the basin was subdivided into physiographic landforms. The Iowa Drift Plain landform has a nearly level to rolling topography. This section of the basin was primarily prairie but has since been converted to agricultural uses. Clay subsoils with low permeability promote rapid runoff. The Kahoka Hills landform is characterized by rolling to rugged, often heavily timbered hills incised into a flat tableland.

Erosive forces have cut steep valleys in the otherwise level topography. This has allowed for a transition zone between Mississippi Valley wooded and prairie habitats. The hills are an expansion of the Mississippi River bluffs that extend along Fox River and the lower Little Fox River to northwest of Kahoka. The side slope soils are generally low in fertility, therefore, support only woodland and pastures. Upland areas, however, are intensely farmed. Streams of this region flow over limestone formations often with gravel or rock substrates. The Mississippi Alluvial Plain landform is essentially the Mississippi River floodplain. The topography is level and the soils are conducive to intensive farming. Streams in this region are of low gradient and are turbid, with sandy or silty substrates.

### **Stream Order**

Stream orders were determined throughout the basin (Figure 3) according to Strahler (1957). Code numbers were assigned to all streams according to Pflieger (1981). Thirty-nine streams were identified in the basin as permanent, intermittent with permanent pools, or ephemeral (Table 1). F ox River is classified as an intermediate size stream at order 5. The Little Fox River and Honey Creek are the only fourth-order streams in the basin. In addition, there are seven third-order and twenty-four second-order streams. Hemp Slough is a former Des Moines/Mississippi River oxbow that empties into Fox River through a network of drainage ditches. It was not assigned a stream order.

#### Watershed Area

Watershed area was determined by digitizer and the computer program PADPAC for streams fourth-order and larger, and for Sugar Creek, a third-order stream. Upstream from the gage station at Wayland, Missouri, Fox River drains 400 square miles; 278 are in Missouri. Third-order and smaller tributaries draw water from 113 square miles and fourth-order tributaries drain 165 square miles in Missouri. The Honey Creek watershed is 82 square miles in which 21 square miles are drained by Sugar Creek, its largest tributary. The Little Fox River watershed encompasses 83 square miles in Missouri.

#### **Channel Characteristics**

Graphs of stream gradient for Fox River and its three largest tributaries were produced from United States Geological Survey 7.5-minute topographic maps (Figures 4a-e). Basin streams were measured and slope determined using a digitizer and the computer program MAPWORK. Average gradient and percent slope data appear in Table 2.

Fox River has a gradient of 4.50 feet/mile from its headwaters to the gage station at Wayland, Missouri. In Missouri, Fox River has an average gradient of 3.00 feet/mile. As a fourth order stream, above its confluence with the Little Fox River, the gradient averages 3.65 feet/mile. Though high gradient areas exist due to local geologic features and channelization, the river is rather uniform in gradient.

In general, Fox River occupies a wide floodplain in the northwestern and southeastern portions of the basin and a somewhat narrow floodplain in the central portion. Channel characteristics are governed by area geomorphology. In the wide floodplain areas, and where channelization has occurred, the channel is characterized by short meanders and long, shallow pools and/or sandy runs. In the Kahoka Hills, where the channel is narrower, large, hairpin meanders occur between long, straight reaches. The river varies with short to long pools separated by short, rocky riffles. Mississippian bedrock is occasionally exposed in this area.

The Little Fox River is characterized by a broad, flat floodplain and a wide sandy channel. The stream typifies an agriculturally converted prairie system with short, shallow pools and cut banks interspersed between long, shallow sandy runs. The overall gradient is higher than Fox River (4.94 feet/mile) which is partially attributable to channelization in the Drift Plain.

Honey Creek and Sugar Creek are relatively high gradient streams for northern Missouri. Both originate near the Kahoka Hills and are characterized by narrow floodplains and channels that align with steep bluffs. Honey Creek emerges on the Drift Plain in a narrow, somewhat straight channel. Oddly, long, sluggish pools with a slough-like appearance characterize that reach. The central portion has entrenched channels with gravel or rock bottoms and approximately a 1:1 pool/riffle ratio. The lower portion of Honey Creek has been channelized. Surface flow usually ceases in this reach as the water infiltrates thick deposits of accreted sand.

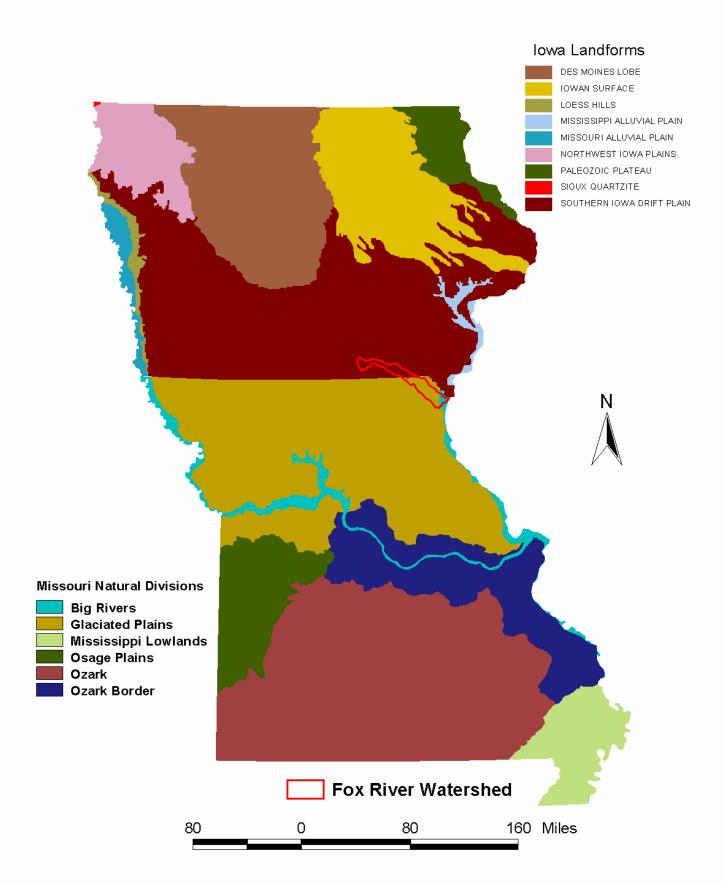


Figure nd. Location of the Fox River Watershed within the natural divisions of Missouri and Iowa.

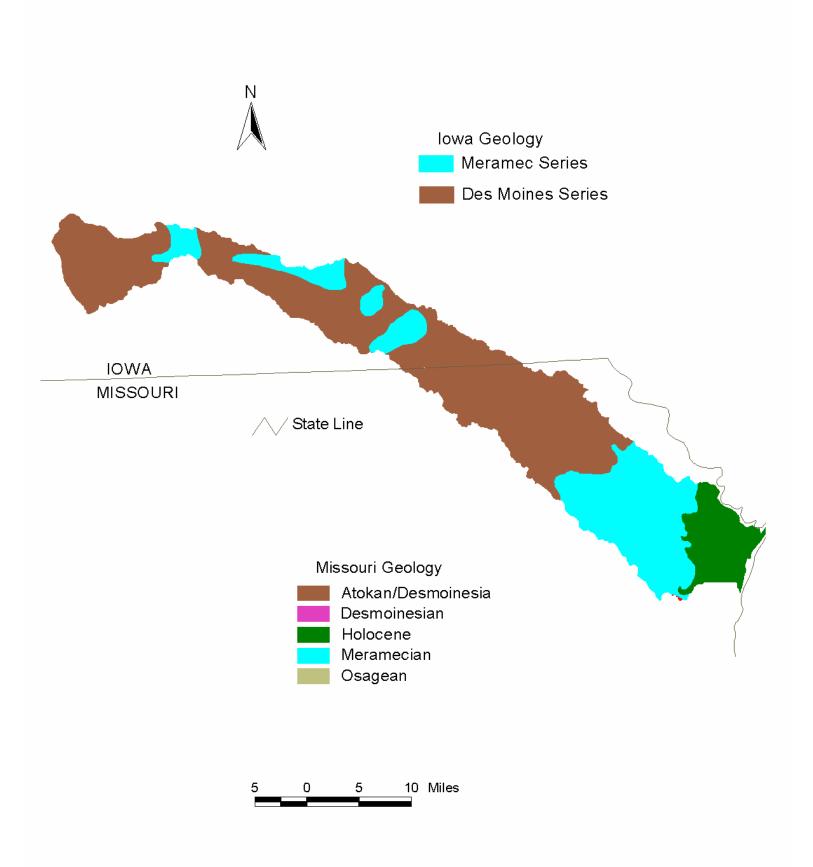
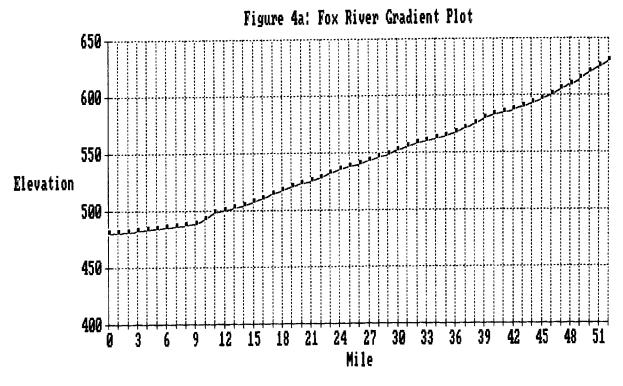
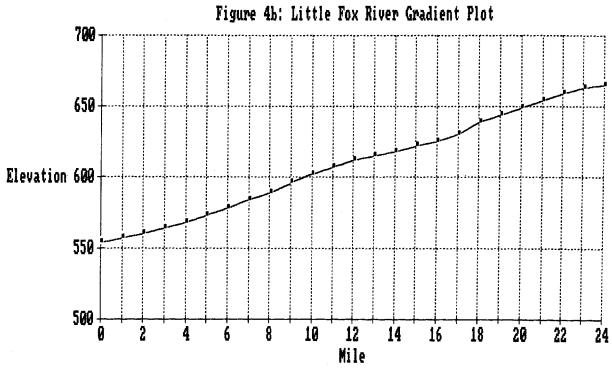


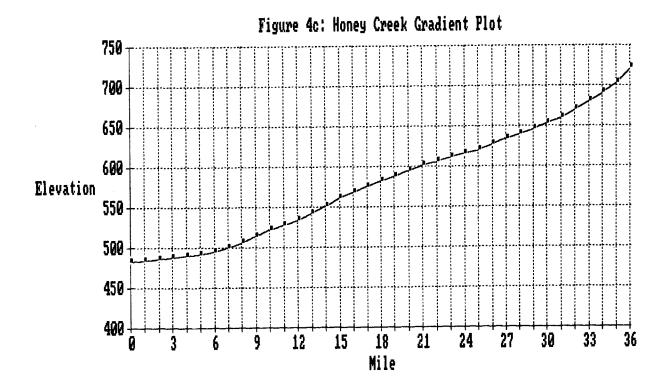
Figure ge. Geology within the Fox River watershed in Missouria and Iowa.

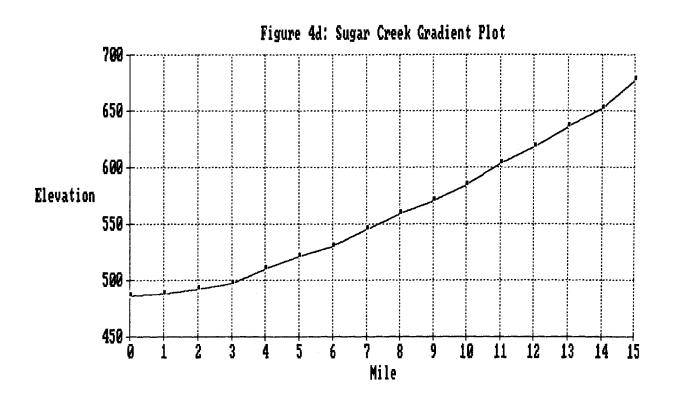
Table 1. Characteristics of stream channels in the Fox River Basin.

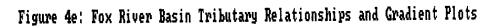
Stream Code	Stream Name	Order	County	T-R-S	Area (sq. mi.)	Miles	MiChan*	Miunch*	%Chan
37500000	Fox River	5	Clark	63-05-06	278	52.3	2.5	49.8	05
37511000	Honey Creek	4	Clark	64-05-18	82	35.8	9.9	25.9	28
37511100	Sugar Creek	3	Clark	64-06-14	21	15.7	6.3	9.4	41
37511110	Unnamed	2	Clark	65-07-33	-	1.8	0.9	0.9	50
37511200	Big Branch	2	Clark	64-06-28	-	3.3	2.0	1.3	61
37511300	Unnamed	2	Clark	64-07-36	-	2.0	0.0	2.0	00
37511400	Unnamed	2	Clark	64-07-35	-	3.2	0.1	3.1	04
37511500	Unnamed	2	Clark	64-07-07	-	4.2	0.4	3.8	10
37511600	Unnamed	2	Clark	65-08-35	-	3.7	0.3	3.4	09
37511700	Unnamed	2	Clark	65-08-26	-	2.8	0.3	2.5	11
37511800	Unnamed	2	Clark	65-08-27	-	4.5	0.2	4.3	05
37512000	Hemp Slough	-	Clark	64-05-18	-	10.2	8.6	1.6	85
37513000	Weaver Branch	2	Clark	65-07-24	-	4.7	1.0	3.7	22
37514000	Brush Creek	2	Clark	65-07-15	-	5.1	2.2	2.9	44
37515000	Singleton Branch	1	Clark	65-07-10	-	2.8	0.0	2.8	00
37516000	Ramsey Branch	2	Clark	65-07-09	-	3.1	0.2	2.9	07
37517000	Johnson Branch	2	Clark	65-07-09	-	3.7	1.2	2.5	33
37518000	Wade Branch	2	Clark	65-08-01	-	3.4	1.1	2.3	33
37521000	Little Fox River	4	Clark	65-08-02	83	23.9	11.8	12.1	49
37521100	Linn Creek	3	Clark	65-08-04	-	2.4	0.6	1.8	25
37521110	South Linn Creek	2	Clark	65-08-31	-	3.8	0.0	3.8	00
37521120	North Linn Creek	2	Clark	66-08-31	-	6.5	0.4	6.1	07
37521200	Wolf Branch	2	Clark	66-09-15	-	5.6	0.1	5.5	02
37521300	Pilcher Branch	2	Clark	66-09-08	-	3.0	0.4	2.6	14
37521400	Smith Branch	2	Clark	66-09-07	-	2.8	0.2	2.6	08
37521500	Turkey Branch	1	Scotland	66-10-12	-	2.4	0.2	2.2	09
37521600	Hughes Branch	3	Scotland	66-10-01	-	5.3	0.8	4.5	15
37521700	Jordan Branch	2	Scotland	67-10-35	-	0.9	0.0	0.9	00
37521710	East Fork Jordan	1	Scotland	67-10-35	-	2.2	0.0	2.2	00
37521720	West Fork Jordan	1	Scotland	67-10-35	-	2.2	0.0	2.2	00
37521800	Unnamed	3	Scotland	67-10-19	-	5.5	0.0	5.5	00
37522000	Unnamed	3	Clark	66-08-23	-	3.0	0.0	3.0	00
37523000	Unnamed	3	Clark	66-08-22	-	3.8	0.0	3.8	00
37524000	Kaylor Branch	2	Clark	66-08-21	-	3.3	0.0	3.3	00
37525000	Mantle Branch	2	Clark	66-08-08	-	4.3	0.1	4.2	03
37526000	Nixon Branch	3	Clark	66-08-05	-	4.0	0.0	4.0	00
37527000	Burnt Shirt Br.	2	Clark	67-09-34	-	6.1	0.2	5.9	04
37528000	Unnamed	2	Clark	67-09-22	-	2.2	0.5	1.6	23
37529000	Unnamed	2	Clark	65-08-22	-	2.4	0.0	2.4	00











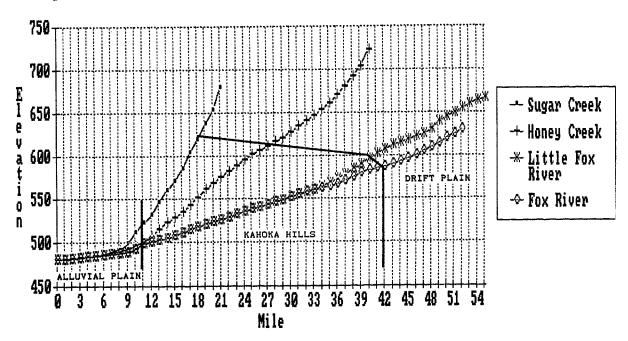


Table 2. Mean Gradient and Slope of Fox River and Its Major Tributaries.

Stream Mile (miles)	Milehead (miles)	Distance (miles)	Elevation (msl)	Stream Order	Gradient (ft/mi)	Percent Slope
FOX RIVER	(mnes)	(IIIIes)	(IIISI)	Order	(11/1111)	Stope
	52.2	2.7	470	5	2.00	057
2.7	52.3 49.6	2.7 6.8	470 480	5	3.00 1.47	.057
9.5				5	1	.028
	42.8	2.4	490		4.17	.080
11.9	40.4	7.4	500	5	2.70	.052
19.3	33.0	6.6	520	5	3.03	.058
25.9	26.4	6.7	540	4	2.99	.057
32.6 38.8	19.7	6.2 7.3	560		3.23	.062
	1.5		580	4	2.74	.052
46.1	6.2 2.0	4.2	600	4	4.76	.091
50.3		2.0	620		3.50	.069
52.3	0.0		627	4		
LITTLE FOX RIV		1.4	550		1.04	004
0.0	23.9	1.4	550	4	4.94	.094
1.4	22.5	4.8	560	4	4.17	.080
6.2	17.7	304	580	4	5.88	.112
9.6	14.3	5.0	600	4	4.00	.076
14.6	9.3	3.5	620	4	5.72	.109
18.1	5.8	3.8	640	4	5.26	.100
21.9	2.0	2.0	660	4	4.00	.076
23.9	0.0		668	4		
HONEY CREEK	1	T	T	Т	1	Т
0.0	35.8	5.2	480	4	6.87	.131
5.2	30.6	1.9	490	3	5.26	.100
7.1	28.7	2.6	500	3	7.69	.147
9.7	26.1	2.9	520	3	6.89	.131
12.6	23.2	2.2	540	3	9.09	.173
14.8	21.0	2.6	560	3	7.69	.147
17.4	18.4	3.0	580	3	6.67	.127
20.4	15.4	4.5	600	3	4.45	.085
24.9	10.9	2.9	620	3	6.89	.131
27.8	8.0	3.2	640	3	6.25	.119
31.0	4.8	2.1	660	1	9.52	.181
33.1	2.7	1.8	680	1	11.11	.211
34.9	0.9	0.7	700	1	28.57	.543
35.6	0.2	0.2	720	1	25.00	.475
35.8	0.0		726	1		
SUGAR CREEK	1	T	T	Ī	1	ı
0.0	15.7	1.6	485	3	13.19	.251
1.6	14.1	2.1	490	3	3.13	.060
3.7	12.0	1.1	500	3	4.76	.091
4.8	10.9	1.9	520	3	18.18	.346
6.7	9.0	1.4	540	3	10.53	.200
8.1	7.6	1.5	560	3	14.29	.272
9.6	6.1	1.5	580	3	13.33	.254
10.7	5.0	1.4	600	3	13.33	.254

Table 2 continued

12.1	3.6	1.2	620	2	14.29	.272
13.3	2.4	1.2	640	2	16.67	.317
14.5	1.2	0.6	660	1	16.67	.317
15.1	0.6	0.6	680	1	33.33	.634
15.7	0.0		692	1	20.00	.380